Equipment and method in a paper or board machine for mixing of fresh stock and of water for dilution of fresh stock

The invention concerns an equipment and a method in a paper or board machine for mixing fresh stock used for manufacture of paper or board with water used for dilution of the fresh stock.

From the prior art, a solution of equipment is known in which fresh stock and a return circulation are passed into a narrowing duct after the wire pit in a paper or board machine. An essential feature of the system is good mixing of fresh stock, white water, and the return circulation.

In an attempt to obtain good mixing of the white water of the short circulation and of fresh stock in a paper/board machine, in the present patent application it is suggested that, in the area in the duct after the wire pit in which the fresh stock is introduced, at least one duct comprises, on its face, a duct form that is wave-shaped in a cross-section perpendicular to the longitudinal axis of the flow duct. Said wave-shaped duct form produces secondary vortexes in the flow, which vortexes result in efficient mixing of the flows.

The equipment in accordance with the present invention is characterized in that, at the point of mixing of the dilution water and the fresh stock passed from the pipe, there is at least one such pipe portion as comprises a wave-shaped form in its connection in the cross-section of the pipe.

The method in accordance with the invention is characterized in that, at the point of mixing of the water used for dilution of fresh stock and the fresh stock passed from the pipe, secondary vortexes are formed, which are formed by means of a wave-shaped face form of the pipe.

The invention will be described in the following with reference to some preferred embodiments of the invention illustrated in the figures in the accompanying drawings, the invention being, yet, not supposed to be confined to said embodiments alone.

Figure 1A illustrates a common embodiment of the invention, in which a water in general, which has been meant for dilution of stock, and a high-consistency stock are mixed while making use of a wave-shaped pipe form.

Figure 1B is a sectional view taken along the line IV - IV in Fig. 1A on an enlarged scale.

Figure 1C is an illustration of principle of the short circulation in a paper/board machine, in which white water that has been recovered as retention is passed into the wire pit, white water being passed from the bottom of the wire pit as a return circulation into the headbox.

Figure 1D is an illustration on a larger scale of an arrangement of equipment in accordance with the invention in which feed pipes of stock and of the return circulation are passed into connection with the white water passed from the bottom portion of the wire pit.

Figure 2A shows a first embodiment of the invention, in which the wave-shaped form has been formed onto the inner wall of the pipe 11 connected with the wire pit.

Figure 2B is a sectional view taken along the line I—I in Fig. 2A.

Figure 3A shows a second embodiment of the invention, in which the wave shape has been formed onto a pipe 13 passed in the interior of the pipe 12.

Figure 3B is a sectional view taken along the line II—II in Fig. 3A.

Figure 4A shows an embodiment of the invention, in which the wave-shaped form has been formed onto the pipe 12.

Figure 4B is a sectional view taken along the line III—III in Fig. 4A.

Fig. 1A illustrates the commonest embodiment of the invention, in which the water V used for dilution of fresh stock M is passed through the pipe 11, and the high-consistency fresh stock M is passed through the pipe 13. At the end of the pipe 13 and after said end, the high-consistency stock M and the water V used for dilution of the stock are mixed with each other owing to the wave formation in accordance with the invention at the end of the pipe 13. In the embodiment shown in Fig. 1A, the wave form extends both to the interior of the pipe 13 and to the outer face of the pipe, in which case the mixing of the water V used for dilution of the fresh stock M with the fresh stock M is efficient. The water passed along the pipe 11 and used for dilution of the stock is favourably white water, which is passed, in the way shown in Fig. 1A, from the tank 100. As is shown in the figure, the tank 100 is a deaeration tank of the short circulation in a paper or board machine, into which tank the white water V is passed from a separate intermediate tank. Thus, in the commonest embodiment of the invention, by means of the wave-shaped pipe construction 13, in general, the high-consistency fresh stock M and the water V that dilutes said stock are mixed with each other efficiently, and the dilution water favourably consists of the white water of the short circulation in the paper/board machine.

Fig. 1B is a sectional view taken along the line IV—IV in Fig. 1A. As is shown in the figure, the line of supply of the high-consistency stock, preferably a pipe 13, is provided with a wave formation at its end. The waves extend both inside and outside the pipe 13, in which case they act both upon the fresh stock M flowing in the pipe 13 and upon the stock dilution water V, favourably white water, flowing outside the pipe 13.

Fig. 1C is an illustration of principle of the use of the white-water pit of the short circulation in a paper or board machine in collecting of retention waters and in

recycling of fibrous white water, in which connection the fresh stock M and the water O of the return circulation are passed into connection with the white water V and in which construction, further, the combined mixed flow is passed from the wire pit 10 into connection with the headbox 100 of the paper or board machine. As is shown in Fig. 1C, the white waters are passed from the wire into the wire pit 10. Into the duct 11 placed at the bottom of the wire pit 10, besides white water V from the wire pit 10, the water O of the return circulation from the tank F and the fresh stock M from the stock tank S are also passed. By means of a pump P, the combined flow $L_1 + L_2 + L_3$ is passed further into the headbox 100.

At the bottom of the wire pit, in accordance with the invention, the white water is mixed with the fresh stock and with the water of the return circulation, which water is, for example, a bypass flow circulation from the headbox or an accept from the second stage of vortex cleaning. The sequence of consistencies is as follows. The highest consistency is that of the high-consistency stock. The next consistency is that of the water from the return circulation, and the lowest consistency is that of the white water (white water < return circulation < high-consistency stock).

Fig. 1D shows an equipment in accordance with the invention, in which, in the way indicated by the arrow L_1, the fibrous water is passed from the white-water pit 10 back to circulation into the pipe 11. Into the pipe 11, also fresh stock M is passed from the pipe 13, and the water O of the return circulation is passed from the pipe 12. The pipe 12 has been passed into the interior of the pipe 11 in an area in which the pipe 11 is curved and its cross-sectional flow area becomes narrower. Through the pipe 12, the return circulation, i.e. the water O of the return circulation, is passed (arrow L_2) into connection with the white water V. Centrally in the interior of the pipe 12, there is the pipe 13. The pipe 13 has been passed coaxially in the interior of the pipe 12. Through the pipe 13 (arrow L_3) the fresh stock M is passed into connection with the water O of the return circulation and with the white water V passed from the wire pit 10. Thus, in the narrowing flow passage in the pipe 11, in the area K, the stock M, the return circulation water O, and the white water V are mixed. As is shown in the figure, the pump P produces suction in the pipe 11, and

by means of the pump P the combined flow $L_1 + L_2 + L_3$ of the components V, M, O is passed further into connection with the headbox 100 of the paper/board machine.

In order that the mixing of the stock M and of the return circulation water O and of the white water V should be as efficient and complete as possible, in the area K of mixing of the flows L_1, L_2 and L_3, at least one of the pipes 11, 12 or 13 is provided with a wave-shaped face form in a cross-section perpendicular to the longitudinal axis of the flow duct. Said wave-shaped face form produces what is called secondary vortexes, which promote the mixing together of the flows L_1, L_2 and L_3.

Fig. 2A is a longitudinal sectional view of the mixing area K and of a first preferred embodiment of the invention. Fig. 2B is a sectional view taken along the line I - I in Fig. 2A. Figs. 2A and 2B show an embodiment in which the pipe 11 has been provided with form pieces $a_1,a_2,a_3\ldots$, whose outer circumference becomes narrower in wedge shape, which have been fitted on the inner face of the pipe 11, and which have been further shaped so that, as shown in the cross-sectional view, the maximal height of the wedge part $a_1,a_2,a_3\ldots$ that produces the wave shape, in the middle of the wedge part a_1, $a_2\ldots$, is placed in the area of the end of the pipe 12 that passes the water O of the return circulation. The pipe 13 that passes the stock M projects further from the interior of the pipe 12.

Fig. 3A is a longitudinal sectional view of a second embodiment of the invention. Fig. 3B is a sectional view taken along the line II—II in Fig. 3A.

In the embodiment shown in Figs. 3A and 3B, the wave shape has been formed onto the central pipe 13 fitted inside the pipe 12. The pipe 13 projects from the pipe 12. Thus, secondary vortexes are produced both in the flow L_2 of the return circulation water O inside the pipe 12 and in the flow L_3 of fresh stock M inside the pipe 13. Thus, by means of the wave-shaped face of the pipe 13, an effect that produces secondary vortexes is applied both to the return circulation water O flowing in the pipe 12 and to the stock M that flows in the pipe 13.

Fig. 4A is a longitudinal sectional view of a third preferred embodiment of the invention. Fig. 4B is a sectional view taken along the line III—III in Fig. 4A.

Figs. 4A and 4B show an embodiment of the invention in which the wave shape has been formed onto the flow pipe 12 so that the wave shape acts upon the flow L_1 of white water V in the pipe 11 and upon the flow L_2 of the return circulation water O in the pipe 12.